Lista de exercícios de Física II

1) $F_{3,1} = F_{2,3} \Rightarrow \frac{K_0 \cdot |Q_1| \cdot |Q_3|}{x^2} = \frac{K_0 \cdot |Q_2| \cdot |Q_3|}{(0,3-x)^2} \Rightarrow \frac{1\times10^{-6}}{x^2} = \frac{4\times10^{-6}}{(0,3-x)^2} \Rightarrow \frac{1}{x^2} = \frac{4}{(0,3-x)^2} \Rightarrow$

$\frac{1}{x} = \frac{2}{0,3-x} \Rightarrow 0,3-x = 2x \Rightarrow 3x = 0,3 \Rightarrow x = 0,1\,m \Rightarrow x = 10\,cm$

2) $|q_1| = |q_2| = |q_3| = q$

$F_{1,2} = F_{2,1} = F_{1,3} = F_{3,1} = F_{2,3} = F_{3,2} = F$

$F = \frac{K_0 \cdot q \cdot q}{d^2} = \frac{9\times10^9 \cdot 3\times10^{-6} \cdot 3\times10^{-6}}{1^2} \Rightarrow F = 8,1\times10^{-2}\,N$

$R_1^2 = R_2^2 = F^2 + F^2 + 2F \cdot F \cdot \cos 120° = F^2 + F^2 + 2F^2\left(-\frac{1}{2}\right) = 2F^2 - F^2 \Rightarrow R_1 = R_2 = F = 8,1\times10^{-2}\,N$

$R_3^2 = 3F^2 \Rightarrow R_3 = F\sqrt{3} \Rightarrow R_3 = 1,4\times10^{-1}\,N$

3) a) $h^2 = 3^2 + 4^2 \Rightarrow h = 5\,cm \Rightarrow h = 5\times10^{-2}\,m$

por simetria: $E_y = 0 \Rightarrow E_{1y} = E_{2y}$

$E_x = 2\,E\cos\theta$

$|q_1| = |q_2| = q$

$E = \frac{K_0 \cdot q}{h^2} = \frac{9\times10^9 \cdot 6\times10^{-9}}{(5\times10^{-2})^2} \Rightarrow E = 2,16\times10^4\,N/C$

$E_x = 2 \cdot 2,16\times10^4 \cdot \frac{4}{5} \Rightarrow E_x = 3,46\times10^4\,N/C \Rightarrow \vec{E} = 3,46\times10^4\,\hat{i}\,N/C$

b) $F = |q_3| \cdot E_x = 2\times10^{-9} \cdot 3,46\times10^4 \Rightarrow F = 6,92\times10^{-5}\,N \Rightarrow \vec{F} = 6,92\times10^{-5}\,\hat{i}\,N$

4) $h^2 = L^2 + L^2 \Rightarrow h^2 = 2L^2 \Rightarrow h = L\sqrt{2}$

$d = \frac{h}{2} \Rightarrow d = \frac{L\sqrt{2}}{2} = \frac{0,6\sqrt{2}}{2} \Rightarrow d = 0,3\sqrt{2}\,m$

$E = \frac{K_0 \cdot |Q|}{d^2} = \frac{9\times10^9 \cdot 1\times10^{-6}}{(0,3\sqrt{2})^2} \Rightarrow E = 5\times10^4\,N/C$

$E_R^2 = (2E)^2 + (2E)^2 \Rightarrow E_R^2 = 4E^2 + 4E^2 \Rightarrow E_R = \sqrt{8} \cdot E = \sqrt{8} \cdot 5\times10^4 \Rightarrow E_R = 1,41\times10^5\,N/C$

5) $V_1 + V_2 = 0 \Rightarrow \frac{K_0 \cdot q}{a/3} + \frac{K_0 \cdot q'}{2a/3} = 0 \Rightarrow q + \frac{q'}{2} = 0 \Rightarrow q = -\frac{q'}{2} \Rightarrow \frac{q}{q'} = -\frac{1}{2}$

6) a) $V_A = \frac{K_0 \cdot Q}{d_A} = \frac{9\times10^9 \cdot 1,2\times10^{-8}}{0,4} \Rightarrow V_A = 270\,V$

$V_B = \frac{K_0 \cdot Q}{d_B} = \frac{9\times10^9 \cdot 1,2\times10^{-8}}{0,6} \Rightarrow V_B = 180\,V$

b) $\tau_{AB} = q(V_A - V_B) = 1\times10^{-6}(270-180) \Rightarrow \tau_{AB} = 9\times10^{-5}\,J$

7) $E_{p_p} = q \cdot V_p = 2\times10^{-3} \cdot 200 \Rightarrow E_{p_p} = 0,4\,J$

8) $A = 4\pi r^2 = 4\pi(0,5)^2 \Rightarrow A = 3,14\,m^2$

$E = \frac{K_0 \cdot |Q|}{d^2} = \frac{9\times10^9 \cdot 2\times10^{-6}}{(0,5)^2} \Rightarrow E = 7,2\times10^4\,N/C$

$\Phi = E \cdot A \cdot \cos 0° \Rightarrow \Phi = E \cdot A = 7,2\times10^4 \cdot 3,14 \Rightarrow \Phi = 2,26\times10^5\,N \cdot m^2/C$

9) a) $R = \frac{\rho_0 \cdot L}{A} = \frac{3,5\times10^{-5} \cdot 3\times10^{-2}}{0,25\times10^{-4}} \Rightarrow R = 4,2\times10^{-2}\,\Omega \Rightarrow R = 42\,m\Omega$

b) $i = \frac{U}{R} = \frac{8,4}{4,2\times10^{-2}} \Rightarrow i = 200\,A$

10) a) $U = 6R_1$ e $U = (R_1+10).2$ $\Rightarrow 6R_1 = (R_1+10).2 \Rightarrow 6R_1 = 2R_1 + 20 \Rightarrow R_1 = 5\,\Omega$

b) $U = 6 \cdot 5 \Rightarrow U = 30\,V$

11) $R_p = \frac{R}{N} \Rightarrow R = N \cdot R_p \Rightarrow R = N \cdot 1,875$

$R_s = N \cdot R \Rightarrow 120 = N \cdot N \cdot 1,875 \Rightarrow 120 = N^2 \cdot 1,875 \Rightarrow N^2 = 64 \Rightarrow N = 8$

12) $i_G = 0 \Rightarrow R \cdot 10 = 15 \cdot 20 \Rightarrow R = 30\,\Omega$

13) a) $R_p = \frac{6 \cdot 12}{6+12} \Rightarrow R_p = 4\,\Omega$

$R_{eq} = 4 + 8 \Rightarrow R_{eq} = 12\,\Omega$

$U = R_{eq} \cdot i \Rightarrow 24 = 12 \cdot i \Rightarrow i = 2A$

$U_p = R_p \cdot i_1 \Rightarrow U_p = 4 \cdot 2 \Rightarrow U_p = 8V$

$U_p = R_1 \cdot i_1 \Rightarrow 8 = 6 \cdot i_1 \Rightarrow i_1 = 1,33A$

$U_p = R_2 \cdot i_2 \Rightarrow 8 = 12 \cdot i_2 \Rightarrow i_2 = 0,67\,A$

b) $P_d = R_3 \cdot i^2 \Rightarrow P = 8 \cdot 2^2 \Rightarrow P_d = 32\,W$

14) a) $V = \frac{Q_1 + Q_2}{C_1 + C_2} = \frac{10\times10^{-6} + 5\times10^{-6}}{2\times10^{-6} + 3\times10^{-6}} \Rightarrow V = 3\,V$

b) $Q_1' = C_1 \cdot V = 2\times10^{-6} \cdot 3 \Rightarrow Q_1' = 6\times10^{-6}\,C \Rightarrow Q_1' = 6\,\mu C$

$Q_2' = C_2 \cdot V = 3\times10^{-6} \cdot 3 \Rightarrow Q_2' = 9\times10^{-6}\,C \Rightarrow Q_2' = 9\,\mu C$

15) a) $Q = C \cdot U \Rightarrow 20\times10^{-6} = 5\times10^{-6} \cdot U \Rightarrow U = 4V$

b) $E_p = \frac{Q \cdot V}{2} = \frac{20\times10^{-6} \cdot 4}{2} \Rightarrow E_p = 4\times10^{-5}\,J \Rightarrow E_p = 40\,\mu J$

16) a) $U = E \cdot d \Rightarrow E = \frac{U}{d} = \frac{100}{1\times10^{-3}} \Rightarrow E = 1\times10^5\,V/m$

b) $C = \varepsilon_0 \cdot \frac{A}{d} = 8,85\times10^{-12} \cdot \frac{2}{1\times10^{-3}} \Rightarrow C = 1,77\times10^{-8}\,F$

c) $E_p = \frac{C \cdot V^2}{2} = \frac{1,77\times10^{-8} \cdot 100^2}{2} \Rightarrow E_p = 8,85\times10^{-5}\,J$

17) $F_e = P \Rightarrow F_e = m \cdot g = 0,512\times10^{-3} \cdot 10 \Rightarrow F_e = 5,12\times10^{-3}\,N$

$U = E \cdot d \Rightarrow 640 = E \cdot 2\times10^{-2} \Rightarrow E = 3,2\times10^4\,N/C$

$E = \frac{F_e}{|q|} \Rightarrow |q| = \frac{F_e}{E} = \frac{5,12\times10^{-3}}{3,2\times10^4} \Rightarrow |q| = 1,6\times10^{-7}\,C$

$|q| = N \cdot e \Rightarrow 1,6\times10^{-7} = N \cdot 1,6\times10^{-19} \Rightarrow N = 1\times10^{12}$ elétrons

18) $C_s = \frac{C_1 \cdot C_2}{C_1 + C_2} = \frac{30\times10^{-6} \cdot 20\times10^{-6}}{30\times10^{-6} + 20\times10^{-6}} \Rightarrow C_s = 1,2\times10^{-5}\,F \Rightarrow C_s = 12\,\mu F$

$Q = C_s \cdot U = 1,2\times10^{-5} \cdot 12 \Rightarrow Q = 1,44\times10^{-4}\,C \Rightarrow Q = 144\,\mu C$

$Q_1 = Q_2 = Q = 144\,\mu C$

$Q_1 = C_1 \cdot U_1 \Rightarrow 1,44\times10^{-4} = 30\times10^{-6} \cdot U_1 \Rightarrow U_1 = 4,8V$

$Q_2 = C_2 \cdot U_2 \Rightarrow 1,44\times10^{-4} = 20\times10^{-6} \cdot U_2 \Rightarrow U_2 = 7,2V$

19) a) $C_0 = \varepsilon_0 \cdot \frac{A}{d} = 8,85\times10^{-12} \cdot \frac{100\times10^{-4}}{4\times10^{-3}} \Rightarrow C_0 = 2,21\times10^{-11}\,F$

b) $C = K \cdot C_0 = 2 \cdot 2,21\times10^{-11} \Rightarrow C = 4,42\times10^{-11}\,F$

c) $V = V_{vácuo} + V_{dielétrico} \Rightarrow V = E_0 \cdot \left(\frac{1}{4}d\right) + E\left(\frac{3}{4}d\right) \Rightarrow V = E_0\left(\frac{1}{4}d\right) + \frac{E_0}{K}\left(\frac{3}{4}d\right) \Rightarrow$

$V = E_0 \cdot d\left(\frac{1}{4} + \frac{3}{4K}\right) \Rightarrow V = V_0\left(\frac{K+3}{4K}\right)$

$C = \frac{Q}{V} = \frac{Q}{V_0(K+3)/4K} \Rightarrow C = \frac{Q}{V_0} \cdot \left(\frac{4K}{K+3}\right) \Rightarrow C = C_0 \cdot \left(\frac{4K}{K+3}\right) \Rightarrow$

$C = 2,21\times10^{-11} \cdot \left(\frac{4.2}{2+3}\right) \Rightarrow C = 3,54\times10^{-11}\,F$

20) $C_1 = \frac{2\pi\varepsilon_0 L}{\ln\left(\frac{r_2}{r_1}\right)} = \frac{2\pi\,8,85\times10^{-12} \cdot 1}{\ln\left(\frac{0,5}{0,2}\right)} \Rightarrow C_1 = 6,07\times10^{-11}\,F$

$C_2 = \frac{2\pi\varepsilon_0 L}{\ln\left(\frac{r_3}{r_2}\right)} = \frac{2\pi\,8,85\times10^{-12} \cdot 1}{\ln\left(\frac{0,8}{0,5}\right)} \Rightarrow C_2 = 1,18\times10^{-10}\,F$

$C = C_1 + C_2 = 6,07\times10^{-11} + 1,18\times10^{-10} \Rightarrow C = 1,79\times10^{-10}\,F \Rightarrow C = 179\,pF$

Lista exercícios 2 – Física II

1) a) $Q = Q_f \cdot (1 - e^{-t/\tau}) = C \cdot \varepsilon \cdot (1 - e^{-2/\tau}) \Rightarrow Q = 1,5\times10^{-6} \cdot 6 \cdot 0,632 \Rightarrow Q = 5,69\times10^{-6}\,C$

b) $i = i_0 \cdot e^{-t/\tau} = \frac{\varepsilon}{R} \cdot e^{-2/\tau} = \frac{6}{2\times10^6} \cdot 0,368 \Rightarrow i = 1,1\times10^{-6}\,A$

c) $P_\mu = \frac{dE_P}{dt} = \frac{1}{2C} \cdot \frac{dQ^2}{dt} = \frac{Q}{C} \cdot i = \frac{5,69\times10^{-6}}{1,5\times10^{-6}} \cdot 1,1\times10^{-6} \Rightarrow P_\mu = 4,17\times10^{-6}\,W$

2) a) $\tau = R \cdot C = 18\times10^3 \cdot 0,15\times10^{-6} \Rightarrow \tau = 2,7\times10^{-3}\,s$

$V = V_0 \cdot (1 - e^{-t/\tau}) \Rightarrow 7 = 9 \cdot (1 - e^{-t/\tau}) \Rightarrow e^{-t/\tau} = 1 - \frac{7}{9} = 0,222 \Rightarrow$

$e^{t/\tau} = 4,505 \Rightarrow t = \tau \cdot \ln(4,505) = 2,7\times10^{-3} \cdot 1,505 \Rightarrow t = 4,06\times10^{-3}\,s$

b) $E_P = \frac{C \cdot V^2}{2} = \frac{0,15\times10^{-6} \cdot 7^2}{2} \Rightarrow E_P = 3,68\times10^{-6}\,J$

c) $E_{bat} = \varepsilon \int_0^t i(t)\,dt = \frac{\varepsilon^2}{R} \int_0^t e^{-t/\tau}\,dt = \frac{\varepsilon^2}{R} \cdot \tau \cdot e^{t/\tau}\Big|_0^t \Rightarrow$

$E_{bat} = \frac{9^2}{18\times10^3} \cdot 2,7\times10^{-3} \cdot (1 - 0,222) \Rightarrow E_{bat} = 9,45\times10^{-6}\,J$

3) $E_c = \frac{m \cdot v^2}{2} \Rightarrow v = \sqrt{\frac{2E_c}{m}} = \sqrt{\frac{2 \cdot 10 \cdot 1,6\times10^{-19}}{9,11\times10^{-31}}} \Rightarrow v = 1,87\times10^6\,m/s$

$R = \frac{m \cdot v}{|q| \cdot B} = \frac{9,11\times10^{-31} \cdot 1,87\times10^6}{1,6\times10^{-19} \cdot 1\times10^{-4}} \Rightarrow R = 0,11\,m$

4) $B_c = \frac{\mu_0 \cdot i}{2R}$ $\quad B_r = \frac{\mu_0 \cdot i}{2\pi r}$

$B_c - B_r = 0 \Rightarrow B_c = B_r \Rightarrow \frac{\mu_0 \cdot i}{2R} = \frac{\mu_0 \cdot i}{2\pi r} \Rightarrow r = \frac{R}{\pi} = \frac{10}{\pi} \Rightarrow r = 3,18\,cm$

5) a) $\Phi_m = N \cdot B \cdot A \cdot \cos 0° = N \cdot B \cdot \pi r^2 = 75 \cdot 400\times10^{-4} \cdot \pi \cdot (3\times10^{-2})^2 \Rightarrow \Phi_m = 8,48\times10^{-3}\,Wb$

b) $N = 75 \cdot \frac{15\times10^{-3}}{8,48\times10^{-3}} \Rightarrow N = 133$ espiras

6) a) $F = |q| \cdot v \cdot B \cdot \operatorname{sen} 90° = 1,6\times10^{-19} \cdot 8,5\times10^{-2} \Rightarrow F = 6,4\times10^{-20}\,N$

b) $v = \frac{E}{B} \Rightarrow E = v \cdot B = 8,5\times10^{-2} \Rightarrow E = 4\times10^{-1}\,V/m$

c) $U = E \cdot d = 4\times10^{-1} \cdot 0,3 \Rightarrow U = 1,2\times10^{-1}\,V$

7) $F_{1,2} = \frac{\mu_0 \cdot i_1 \cdot i_2 \cdot l}{2\pi d} = \frac{4\pi\times10^{-7} \cdot 1 \cdot 5 \cdot 1}{2\pi \cdot 1} \Rightarrow F_{1,2} = 1\times10^{-6}\,N$

$F_{3,2} = \frac{\mu_0 \cdot i_3 \cdot i_2 \cdot l}{2\pi d} = \frac{4\pi\times10^{-7} \cdot 2 \cdot 5 \cdot 1}{2\pi \cdot 1} \Rightarrow F_{3,2} = 2\times10^{-6}\,N$

$F = F_{3,2} - F_{1,2} = 2\times10^{-6} - 1\times10^{-6} \Rightarrow F = 1\times10^{-6}\,N$

8) $|\varepsilon| = \frac{d\Phi_m}{dt} = A \cdot \frac{dB}{dt} = \pi r^2 \cdot \frac{dB}{dt} = \pi \cdot (5\times10^{-2})^2 \cdot 40\times10^{-3} \Rightarrow |\varepsilon| = 3,14\times10^{-4}\,V$

9) $M = \mu_0 \cdot n_1 \cdot n_2 \cdot l \cdot \pi r_1^2 = \frac{\mu_0 \cdot N_1 \cdot N_2 \cdot \pi \cdot r_1^2}{l} = \frac{4\pi\times10^{-7} \cdot 300 \cdot 1000 \cdot \pi \cdot (0,02)^2}{0,25} \Rightarrow$

$M = 1,89\times10^{-3}\,H$